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PATENT & TRADEMARK OFFICE

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Docket No.: M4065.0101/P101
(PATENT)

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Patent Application of:
Howard E. Rhodes

Application No.: 09/172,298

Confirmation No.: 9094

Filed: October 14, 1998 (RCE)

Art Unit: 2811

For: CMOS IMAGER HAVING A NITRIDE DIELECTRIC

Examiner: G.M. Munson

## APPEAL BRIEF

U.S. Patent and Trademark Office
220 20th Street S.
Customer Window, Mail Stop Appeal Brief-Patents
Crystal Plaza Two, Lobby, Room 1B03
Arlington, VA 22202

Dear Sir:

This is an Appeal Brief pursuant to 35 U.S.C. § 134 and 37 C.F.R. §§ 41.31 et seq. from the final rejection of claims 1-4, 7-15, 18-23, 25-29, 31-39, 41-63, 65, and 115-144 of the above-identified application. The Notice of Appeal was filed on November 12, 2004. The fee for submitting this Brief in accordance with 37 C.F.R. § 1.17(c) is attached. Any deficiency in the fees associated with this Brief should be charged to Deposit Account No. 04-1073.

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## I. REAL PARTY IN INTEREST

The real party in interest in this appeal is MICRON TECHNOLOGY, INC., a Corporation of the State of Delaware, and the assignee of this application.

## II. RELATED APPEALS AND INTERFERENCES

There are no other appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

## III. STATUS OF CLAIMS

### A. Current Status of Claims

1. Claims canceled: 5-6, 16-17, 24, 30, 40, 64, 66-114, and 145-149
2. Claims withdrawn from consideration but not canceled: none
3. Claims pending: 1-4, 7-15, 18-23, 25-29, 31-39, 41-63, 65, and 115-144
4. Claims allowed: none
5. Claims rejected: 1-4, 7-15, 18-23, 25-29, 31-39, 41-63, 65, and 115-144

### B. Claims on Appeal

The claims on appeal are claims 1-4, 7-15, 18-23, 25-29, 31-39, 41-63, 65, and 115-144.

## IV. STATUS OF AMENDMENTS

A final Office Action was mailed August 18, 2004. In response to the final Office Action, Appellants filed a Notice of Appeal on November 12, 2004. No

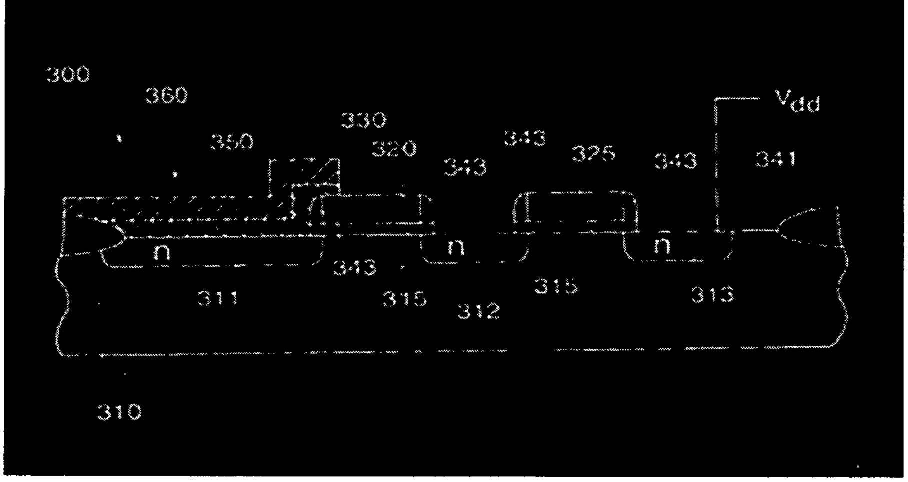
amendments have been submitted subsequent to the August 18, 2004 final Office Action.

## V. SUMMARY OF CLAIMED SUBJECT MATTER

The present invention relates to an imaging device 300 formed as a CMOS semiconductor integrated circuit including a nitrogen containing insulating layer 330 beneath a photogate 360. (Application at 41, lines 2-4; with numeric reference to FIG. 10, reproduced below on the next page). The nitrogen containing insulating layer "provides increased capacitance in the CMOS imager, better breakdown voltage than prior $SiO_2$ insulators, better breakdown voltage characteristics between the photogate and transfer gate...and a wider dynamic range." (Application, at 13, lines 10-17). In accordance with one embodiment, the claimed imaging device has two gate stacks that comprise respective conductive layers 320, 325 over an insulating layer 315, which is distinct from the nitrogen containing insulating layer 330. (Application at 15, lines 29-31; 16, lines 13-15). The non-nitrogen containing insulating layer is preferably "a silicon dioxide layer which may be formed, i.e., grown, by conventional methods." (Application at 15, lines 20-24).

The invention also relates to an imaging system having a photogate 360, "wherein a nitrogen containing insulating layer (330) is in contact with said substrate (310) and beneath said photogate (360)." The invention also relates to a system comprising "a processor for processing image data; and a CMOS imaging device for providing image data," the CMOS imaging device including a photogate and "a nitrogen containing insulating layer in contact with [a] substrate and beneath said photogate." (Application at 19, lines 10-14; FIG. 10; FIG. 12).

FIG. 10




VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1-4, 7-13 and 120 are finally rejected under 35 U.S.C. §102 as "unpatentable as shown by" Anagnostopoulos et al. (U.S. Patent No. 5,804,845).

Claims 1, 3, 7, 12, 14, 15, 18, 19, 26, 28, 29, 31-33, 38, 39, 41, 42, 44, 46, 51, 53, 55, 57-59, 115-125, and 135-139 are finally rejected under 35 U.S.C. §103 as being unpatentable over acknowledged prior art and Nagasaki et al. (U.S. Patent No. 5,307,169).

Claims 2, 4, 25, 27, 43, 45, 54, 56, 126-134 and 140-144 are finally rejected under 35 U.S.C. §103 as being unpatentable over the acknowledged prior art and Nagasaki, further considered together with Koike et al. (U.S. Patent No. 4,143,389).

Claims 2, 8, 10, 11, 20, 22, 23, 25, 34, 36,37 43, 47, 49, 50, 54, 60, 62, and 63 are finally rejected under 35 U.S.C. §103 as being unpatentable over the acknowledged prior art and Nagasaki, further considered together with Suzuki (U.S. Patent No. 4,385,307).

Claims 1-4, 7-15, 18-23, 25-29, 31-39, 41-63, 65, 115-125 and 135-139 are finally rejected under 35 U.S.C. §103 as being unpatentable over the acknowledged prior art and Nagasaki, further considered together with Okada et al. (U.S. Patent No. 5,241,198) and Anagnostopoulos.

Claims 126-134 and 140-144 are finally rejected under 35 U.S.C. §103 as being unpatentable over the acknowledged prior art and Nagasaki, Okada, and Anagnostopoulos, further considered together with Koike.

## VII. ARGUMENT

### A. <u>CLAIMS 1-4, 7-13 AND 120 ARE PATENTABLE OVER ANAGNOSTOPOULOS ET AL. (U.S. PATENT NO. 5,804,845)</u>

Claims 1-4, 7-13 and 120 each recite "a first insulating layer in contact with said substrate and beneath each of said first and second gate stacks; and a nitrogen containing second insulating layer distinct from said first insulating layer." The second insulating layer is "in contact with said substrate and . . . located beneath [a] photogate."

In contrast to the claimed invention, each of the embodiments shown in Figures 3A-3C of Anagnostopoulos and described in the accompanying text shows only one layer contiguous with the substrate. Specifically, Anagnostopoulos does not teach both a "first insulating layer in contact with said substrate and beneath each of said first and second gate stacks," and "a nitrogen containing second insulating layer distinct from said first insulating layer, said second insulating layer being in contact with said substrate and being located beneath said photogate." With reference to Figures 3B and 3C, the Office Action states that the first insulating layer reads on silicon oxide layer 43

and layer 52, while the "'nitrogen containing second insulating' layer reads on an ONO layer (Figure 3B) or NO layer (Figure 3C). (August 18, 2004 Office Action, at 3). Even assuming, *arugendo,* that the electrode 30 represents a photogate, which is not stated, Anagnostopoulos still does not anticipate the claimed invention for at least two reasons.

First, as shown in Figures 3B and 3C, the entire ONO and NO layers, respectively, run beneath both the electrode 30 and gate stack electrodes 32. Anagnostopoulos explains that "ITO electrodes 30 and polysilicon electrodes 32 are formed upon an ONO stack comprising three layers that completely run beneath the electrodes." (Col. 5, lines 15-17). Put another way, the ONO and NO layers, while containing nitrogen, are not distinct from the first layers 43 and 52 identified by the Office Action as anticipating the claimed "first insulating layer" because the ONO layer includes layer 43 as an oxide layer, similarly, the NO layer includes layer 52 as the oxide layer. Accordingly, Anagnostopoulos does not teach or suggest a "first insulating layer in contact with said substrate and beneath each of said first and second gate stacks" and "a nitrogen containing second insulating layer, *distinct* from said first insulating layer," (emphasis added) as recited by independent claim 1. The term "distinct," as recited by claim 1, is used according to its ordinary meaning, "distinguishable to the eye or mind as discrete: SEPARATE." WEBSTER'S COLLEGIATE DICTIONARY 337 (10th ed. 2001). The insulating layers taught by Anagnostopoulos are not distinct, or separate, layers, as in the claimed invention; but rather, one layer 43 is a part of a larger layer ONO.

Second, even if layers 43 and 52 are "distinct" from the nitrogen containing layer, the structure of Anagnostopoulos still does not anticipate the claimed invention because it fails to show that the nitrogen containing layer is "in contact with said

substrate." The layers disclosed by Anagnostopoulos as being in contact with said substrate are layers 43 and 52, both being oxide, not "nitrogen containing layers."

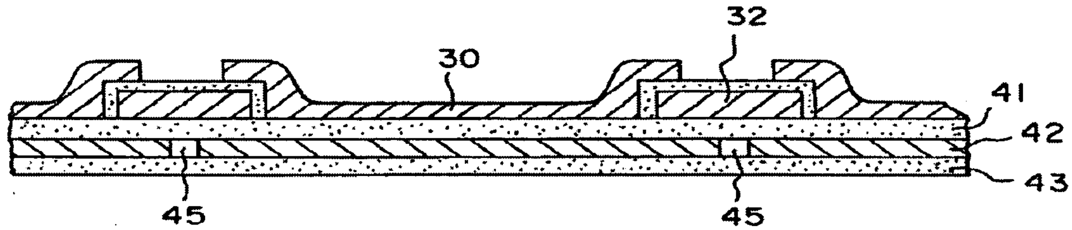



FIG. 3B

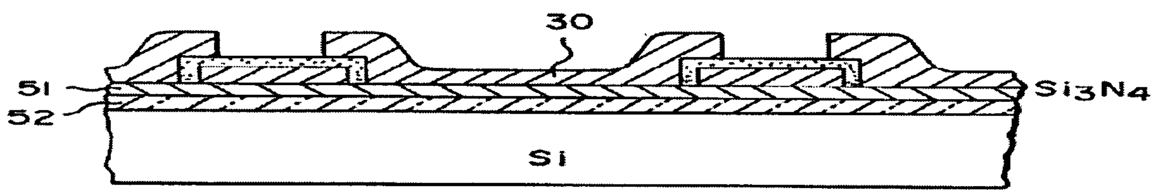



FIG. 3C PRIOR ART

Further, Appellant turns the attention of the Board to dependent claims 9 and 13 which recite that the claimed "nitrogen containing layer is [an] ONO" layer. As claims 9 and 13 each depend indirectly from claim 1, they require a "first insulating layer in contact with [a] substrate" and a *distinct* ONO insulating layer "in contact with said substrate and . . . located beneath said photogate." In FIG. 3B, Anagnostopoulos teaches an ONO insulating layer, but not being "distinct from said first insulating layer," as required by the claim because the ONO is the only insulating layer. Accordingly, there is no teaching in Anagnostopoulos of the claimed first and distinct, nitrogen containing second insulating layers.

In order to maintain a rejection under 35 USC § 102, it is required that "each and every element as set forth in the claim is found, either expressly or inherently

described, in a single prior art reference." MPEP § 2131 (quoting *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631 (Fed. Cir. 1987)). For at least these reasons, Appellant respectfully submits that the rejection of claims 1-4, 7-13, and 120 under 35 U.S.C. §102(b) should be reversed.

B CLAIMS 1, 3, 7, 12, 14, 15, 18, 19, 26, 28, 29, 31-33, 38, 39, 41, 42, 44, 46, 51, 53, 55, 57-59, 115-125, AND 135-139 ARE PATENTABLE OVER THE ACKNOWLEDGED PRIOR ART AND NAGASAKI ET AL. (U.S. PATENT NO. 5,307,169)

1. Claims 1, 3, 7, 12, 115, 120, 125, and 135

The Examiner has failed to establish a *prima facie* case of obviousness with respect to claims 1, 3, 7, 12, 115, 120, 125, and 135. First, neither the acknowledged prior art nor Nagasaki, whether considered alone or in combination, teach or suggest all the limitations of claims 1, 3, 7, 12, 115, 120, 125, and 135. For example, the asserted combination fails to teach or suggest the claimed imaging device comprising, *inter alia*, a "nitrogen containing second insulating layer distinct from said first insulating layer, said second insulating layer being in contact with said substrate and being located beneath said photogate," as recited by independent claim 1.

In fact, neither the acknowledged prior art nor Nagasaki teach or suggest an imaging device having "a first insulating layer ... beneath each of said first and second gatestacks" and a distinct "second nitrogen containing insulating layer" located beneath a photogate. None of the references teach or suggest a nitrogen containing insulating layer located beneath a photogate different than a first insulating layer located beneath two gatestacks. As seen in FIG. 1, shown below, only one insulating layer 22 is utilized in conventional CMOS pixel cells 14, meaning the same insulating layer 22 is beneath the photogate 24 and the gatestacks for the transfer 28 and reset 32 transistors. Further, the prior art relied on by the Examiner utilizes an insulating

material such as silicon dioxide for the insulating layer 22, not the claimed nitrogen containing layer.

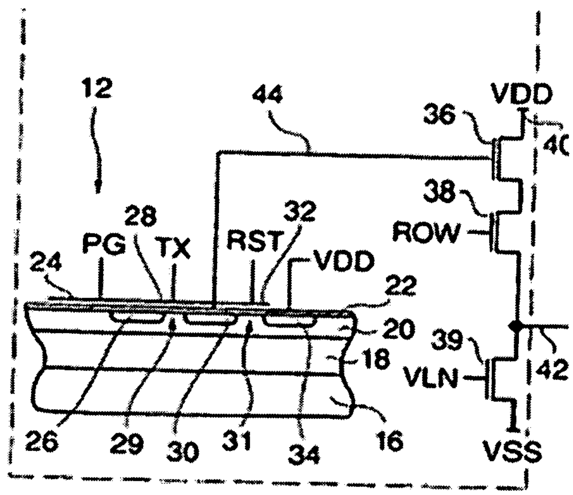
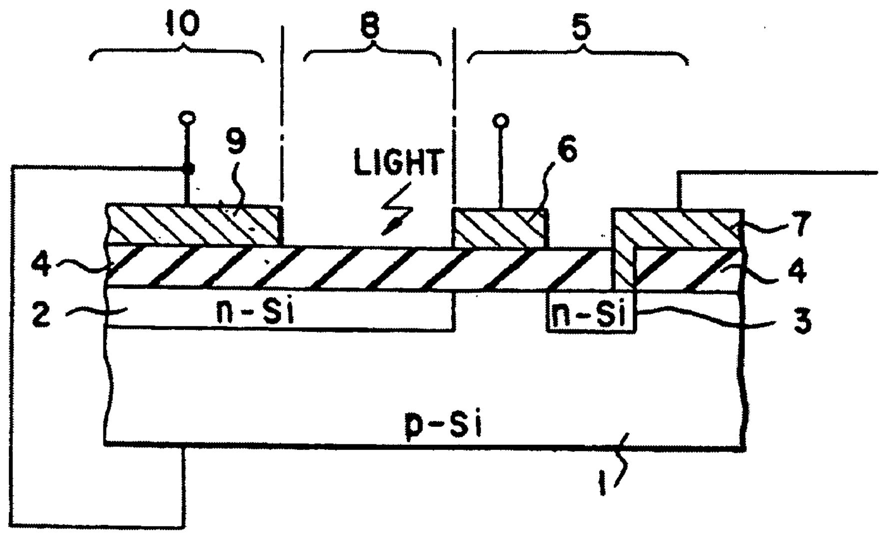



FIG. 1

Similarly, Nagasaki teaches one insulating layer located beneath electrodes. As shown in FIG. 1 reproduced here, only one insulating film 4 is located between the substrate 1 and the electrodes 6 and 9. This insulating film 4 is shown as the only insulating material located in contact with the substrate 1 or being located beneath the electrodes.




F I G. 1

Accordingly, Nagasaki provides no motivation to selectively modify the teachings of the prior art in order to arrive at the claimed invention, because like the prior art, Nagasaki also teaches only one insulating layer. Neither Nagasaki nor the prior art of record teach or suggest an imaging device having "a first insulating layer ... beneath each of said first and second gatestacks" and a distinct "second nitrogen containing insulating layer" located beneath a photogate. Thus, these references do not render obvious the claimed invention as recited by claim 1.

Second, a person of ordinary skill in the art would not have been motivated to replace the insulating layer of the prior art with a "nitrogen containing second insulating layer" as to arrive at the claimed invention based on the teachings of Nagasaki. The acknowledged prior art discloses only a silicon dioxide insulating layer (Application, p. 6, line 22); moreover, Nagasaki, at best, provides no motivation, and more accurately, teaches away from use of a nitrogen containing material as an insulator.

While Nagasaki teaches the use of a "high dielectric material having a high relative dielectric constant" (col. 11, lines 20-22) as an insulating film, Nagasaki also teaches that nitrogen containing materials are low dielectric constant materials, while antiferroelectrics and ferroelectrics are high dielectric materials. (col. 3, lines 20-28). Nagasaki, being its own lexicographer, defines a "low dielectric material" as a material "having [a] relative dielectric constant of 20 or less." (col. 3, lines 20-22). See *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996) ("Although words in a claim are generally given their ordinary and customary meaning, a patentee may choose to be his own lexicographer and use terms in a manner other than their ordinary meaning, as long as the special definition of the term is clearly stated in the patent specification or file history.").

In Table 1 (col. 3, lines 7-19), Nagasaki discloses that $SiO_2$ is a "low dielectric material" with a relative dielectric constant of 4.5, and that $Si_3N_4$ is a "low dielectric material" with a relative dielectric constant of 10. Every other entry in Table 1, none of which includes nitrogen, is described as a "high dielectric material." Thus, the only nitrogen containing material suggested by Nagasaki is a "low dielectric material. Nagasaki thereafter excludes the use of low dielectric materials for use as an insulating film. (col. 4, line 57; col. 5, line 42; col. 6, line 33; col. 6, lines 57-59). Accordingly, Nagasaki teaches away from using a nitrogen-containing layer as an appropriate insulator material for his invention.

TABLE 1

| Insulating Layer | Relative | Dielectric Constant | |
|---|---|---|---|
| $SiO_2$ | 4.5 | dielectric substance | low dielectric material |
| $Si_3N_4$ | 10 | dielectric substance | low dielectric material |
| $Ta_2O_5$ | 22 | dielectric substance | high dielectric material |
| $Pb(Mg_{0.5}W_{0.5})O_3$ | 100 | antiferroelectric substance | high dielectric material |
| $TiO_2$(rutile) | 130 | dielectric substance | high dielectric material |
| $PbZrO_3$ | 150 | antiferroelectric substance | high dielectric material |
| $SrTiO_3$ | 300 | dielectric substance | high dielectric material |
| PZT | 1000 | ferroelectric substance | high dielectric material |
| $BaTiO_3$ | 2000 | ferroelectric substance | high dielectric material |

Simply because $Si_3N_4$, or any other nitrogen containing compound, has a higher relative dielectric constant than $SiO_2$, that does not mean that the nitrogen containing $Si_3N_4$ would be acceptable to Nagasaki. Rather, Nagasaki teaches the use of a "high dielectric material having a high relative dielectric constant," and the only nitrogen containing material discussed in the reference, $Si_3N_4$, is coined by Nagasaki as being a "low dielectric material." Accordingly, neither the acknowledged prior art nor Nagasaki teach or suggest "a nitrogen containing insulating layer...being located beneath said photogate," as recited by claim 1.

Finally, a person of ordinary skill in the art would not have been motivated to combine the teachings of the acknowledged prior art with those of Nagasaki to achieve the claimed invention. Specifically, Nagasaki teaches the use of a photodiode 8 as a "light receiving surface," not the claimed photogate. One of skill in the art would not have been motivated to combine an imaging device utilizing a photodiode as a photosensor with the acknowledged CMOS imaging device that utilizes a photogate device as a photosensor. Therefore, there is no motivation to combine these teachings as necessary to arrive at the claimed invention. Rather, the final rejection is using impermissible hindsight by using the claims of the present invention as a road map to improperly combine the references. *See Ex parte Clapp*, 227 U.S.P.Q. 972, 973 (Bd. App. 1985); M.P.E.P. §2144. This is another reason why the rejection should be reversed.

Each of claims 3, 7, 12, 115, 120, 125, and 135 depend from claim 1 and contain all of the limitations recited therein. Appellant points the Board's attention to claims 7 and 12 which recite that the "nitrogen containing insulating layer is a silicon nitride layer." This compound, $Si_3N_4$, is specifically labeled a "low dielectric material" by Nagasaki, and therefore Nagasaki explicitly teaches away from using this material as an insulator. See Table 1.

For at least these reasons, Appellant respectfully submits that the rejection of claims 1, 3, 7, 12, 115, 120, 125, and 135 under 35 USC 103 should be reversed.

2. Claims 14, 15, 18, 19, 26, 28, 29, 31-33, 38, 39, 41, 42, 44, 46, 51, 53, 55, 57-59, 116-124, and 136-139

Independent claim 14 recites an "imaging device including a semiconductor integrated circuit substrate... comprising... a nitrogen containing insulating material in contact with said substrate and beneath said photogate." Independent claims 28 and 39 also recite imaging systems comprising, *inter alia,* "a nitrogen containing insulating material in contact with said substrate and beneath said photogate." Similarly, independent claim 53 recites a system comprising "a CMOS imaging device. . . including. . . a nitrogen containing insulating layer in contact with said substrate and beneath said photogate." The remaining claims in this section depend from one of independent claims 14, 28, 39, and 53.

It is submitted that similar to the reasons given above, neither the acknowledged prior art nor Nagasaki, whether considered alone or in combination, teach or suggest all of the claim limitations recited by independent claims 14, 28, 29, and 53. Specifically, neither the acknowledged prior art nor Nagasaki teach or suggest the claim limitation reciting "a nitrogen containing insulating layer" being located "in contact with said substrate and beneath said photogate." Further, one of ordinary skill

in the art would not have been motivated to combine the teachings of a photogate as in the acknowledged prior art with the teachings of the photodiode structure taught by Nagasaki, as necessary to arrive at the claimed invention. Neither provides an objective motivation to combine; nor would one of ordinary skill in the art had such motivation to combine the solid state imaging device having a photodiode as taught by Nagasaki, with the prior art CMOS imaging device having a photogate.

In addition, Appellant points the Board's attention to claims 19, 33, 38, 46, and 59 which recite that the "nitrogen containing insulating layer is a silicon nitride layer." This compound, $Si_3N_4$, is specifically labeled a "low dielectric material" by Nagasaki, and therefore Nagasaki explicitly teaches away from using this material as an insulator. (See Table 1 and discussion above).

For at least these reasons, Appellant respectfully submits that the rejection of claims 1, 3, 7, 12, 14, 15, 18, 19, 26, 28, 29, 31-33, 38, 39, 41, 42, 44, 46, 51, 53, 55, 57-59, 115-125, and 135-139 under 35 U.S.C. §103 should be reversed.

C. <u>CLAIMS 2, 4, 25, 27, 43, 45, 54, 56, 126-134 AND 140-144 ARE PATENTABLE OVER THE ACKNOWLEDGED PRIOR ART AND NAGASAKI ET AL. (U.S. PATENT NO. 5,307,169), AND FURTHER IN VIEW OF KOIKE ET AL (U.S. PATENT NO. 4,143,389)</u>

Claims 2, 4, 25, 27, 43, 45, 54, 56, 126-134 and 140-144 are each dependent claims, depending from one of the independent claims 1, 14, 28, 39, and 53 discussed above. For all of the reasons given above, claims 1, 14, 28, 39, and 53 are allowable over the prior art and Nagasaki, whether considered alone or in combination.

Claims 2, 4, 25, 27, 43, 45, 54, 56, 126-134 and 140-144 add additional limitations to the independent claims relating to the particular layout of the photogate

structure. For example, claims 2, 25, 43, and 54 each recite that the photogate includes a "doped polysilicon layer" being located over the nitrogen containing insulating layer. Similarly, claims 4, 27, 45, and 56 each recite that the photogate comprises a transparent material layer comprising one of "indium-tin-oxide, tin oxide, indium oxide and doped hydrogenated amorphous silicon," located over the nitrogen containing insulating layer. The Final Office Action states that "the claimed materials are conventional. . . as shown by Koike et al." (August 18 Office Action, at 4) (Parentheticals excluded).

For whatever Koike teaches regarding the use of specific materials, Koike does not teach the specific materials as used in the claimed invention. For example, Koike does not teach the use of indium-tin-oxide to form a photogate electrode over a nitrogen containing insulating layer. In fact, rather than a nitrogen layer, Koike states that silicon dioxide is "generally employed" for this purpose. (col. 2, line 53). Further, the Board's attention is also directed to claims 131-134, which require that the photogate and the "nitrogen containing layer" are at least "partially disposed over" a gate stack; and the Board's attention is directed to claims 140-144 which recite that the "nitrogen containing second insulating layer is disposed over a portion of [a] transfer gate stack." To the extent that Koike teaches anything about a photogate and an insulating layer formed over a gatestack, Koike states that an electrode 22 "is provided so as to cover the photodiode area over the second *oxide* film 21." (Emphasis added). The oxide film 21 is shown in FIG. 1 as being over a gatestack 18. However, Koike provides no teaching of a photogate and a "nitrogen containing layer" located "partially disposed over" a gatestack, or specifically, a transfer gate stack, as recited by the claimed invention.

Furthermore, Koike does not cure the deficiencies of the other references as discussed above. Specifically, Koike does not teach or suggest a "nitrogen containing layer" located in contact with the substrate and beneath the photogate. Nor does Koike

provide the missing motivation to combine the CMOS photogate prior art structure with the solid state imaging device using a photodiode, as taught by Nagasaki.

For at least these reasons, Appellant respectfully submits that the rejection of claims 2, 4, 25, 27, 43, 45, 54, 56, 126-134 and 140-144 under 35 U.S.C. §103 should be reversed.

D. CLAIMS 2, 8, 10, 11, 20, 22, 23, 25, 34, 36,37 43, 47, 49, 50, 54, 60, 62, AND ARE PATENTABLE OVER ACKNOWLEDGED PRIOR ART AND NAGASAKI ET AL., AND FURTHER IN VIEW OF SUZUKI (U.S. PATENT NO. 4,385,307)

Claims 8, 10, 11, 20, 22, 23, 34, 36, 37, 47, 49, 50, 60, 62, and 63 each depend from one of the independent claims 1, 14, 28, 39, and 53. Dependent claims 8, 10, 11, 20, 22, 23, 34, 36, 37, 47, 49, 50, 60, 62, and 63 provide further limitation on the claimed "nitrogen containing layer." Claims 8, 20, 34, 47, and 60 recite that this layer is a "nitrogen oxide containing layer." Claims 10, 22, 36, 49, and 62 recite that the layer is an "NO" layer. Claims 11, 23, 37, 50, and 63 recite that the layer is an "ON" layer. The Final Office Action states that "[t]he claimed materials (NO or ON) used by Suzuki, are known to have a higher dielectric constant . . .which would have been obvious to use for a photogate insulator in order to achieve a higher capacity for the photogate." (August 18, 2004 Office Action, at 5).

Please note that neither Nagasaki nor the acknowledged prior art provide any motivation for using either of the claimed materials (NO or ON) as a photogate insulator. Nagasaki, which suggests using "a capacitor insulating film being made of a high dielectric material," does not suggest using these materials as a photogate insulator, nor does Nagasaki teach or suggest that the claimed materials are high dielectric materials. In fact, for the reasons outlined above, Nagasaki teaches away

from the concept that nitrogen containing materials are high dielectric materials appropriate for use as insulators.

In addition, Suzuki provides no motivation for the combination made in the Final Office Action. Aside from specifically mentioning an insulating film comprising "a composite construction of a silicon nitride film and a silicon oxide film," Suzuki makes no mention of using a photogate as a photosensor. (Col. 4, lines 30-32). In fact, Suzuki teaches a solid state imaging device utilizing CCD technology. See Figs. 7 and 8 and associated text. (For a discussion of the differences between CCD technology and CMOS imager applications, see generally the Application, p. 1, line 18-p. 3, line 20). It follows, then, that one of ordinary skill in the art would not have been motivated to combine the acknowledged CMOS photogate structure, with the imaging device utilizing a photodiode as taught by Nagasaki, further combined with the CCD imager as taught by Suzuki, as suggested by the Final Office Action to achieve the claimed invention.

The content of claims 2, 25, 43, and 54 was discussed above with respect to the previous rejection. Suzuki provides no further teachings to cure the deficiencies with the acknowledged prior art and Nagasaki, discussed above with respect to these claims. Thus, for the reasons already stated, the cited prior art does not render these claims obvious.

For at least these reasons, Appellant respectfully submits that the rejection of claims 2, 8, 10, 11, 20, 22, 23, 25, 34, 36,37 43, 47, 49, 50, 54, 60, 62, and 63 under 35 U.S.C. §103 should be reversed.

E. CLAIMS 1-4, 7-15, 18-23, 25-29, 31-39, 41-63, 65, 115-125 AND 135-139 ARE PATENTABLE OVER THE ACKNOWLEDGED PRIOR ART AND NAGASAKI ET AL., AND FURTHER IN VIEW OF OKADA ET AL. ( U.S. Patent No. 5,241,198) AND ANAGNOSTOPOULOS ET AL.

Claims 1-4, 7-13, 115, 120, 125, and 135 each recite an imaging device comprising "a photogate for controlling the accumulation of photo-generated charge" in a photosensitive area of a substrate, a "first insulating layer in contact with said substrate" and "a nitrogen containing second insulating layer distinct from said first insulating layer" and located "in contact with said substrate . . . beneath said photogate." Claims 14-15, 18-23, 25-29, 31-39, 41-63, 65, 116-119, 121-124, and 136-139 each recite a "photogate" formed over a substrate and a "nitrogen containing insulating" layer beneath the photogate and "in contact with" the substrate. For whatever Okada teaches regarding the use of an ONO layer as an insulating film for a transfer gate of a CCD device, Okada does not cure the deficiencies of the other references as discussed above. (col. 1, lines 9-15). For example, Okada provides no motivation to selectively replace the known silicon dioxide insulating layer under the photogate with a nitrogen containing layer, as recited by the claimed invention.

Moreover, one of ordinary skill in the art would not have been motivated to combine the reference teachings as suggested by the Final Office Action. The Final Office Action points to no objective motivation suggested by the references for combining the CMOS photogate pixel described in the prior art (FIG. 1 of Application) with the CCD pixels taught by Anagnostopoulos and Okada together with the solid state imager using a photodiode, as taught by Nagasaki.

For at least these reasons, and for all of the reasons stated above with respect to the allowability of these claims, Appellant respectfully submits that the rejection of

claims 1-4, 7-15, 18-23, 25-29, 31-39, 41-63, 65, 115-125 and 135-139 under 35 U.S.C. §103 should be reversed.

### F. CLAIMS 126-134 AND 140-144 ARE PATENTABLE OVER THE ACKNOWLEDGED PRIOR ART AND NAGASAKI ET AL., OKADA, AND ANAGNOSTOPOULOS ET AL., AND FURTHER IN VIEW OF KOIKE ET AL.

Claims 126-134 and 140-144 each depend from one of the independent claims 1, 14, 28, 39, and 53 discussed above. Claims 126-129 provide that the claimed imaging device (and/or imaging system) further comprises "a gate stack. . . over an insulating layer of silicon dioxide disposed over said substrate" and beneath said nitrogen containing layer. Claims 130-134 each depend respectively from claims 126-129 and recite further that the "photogate and said nitrogen containing insulating layer are only partially disposed over said gate stack." Claims 140-144 depend from claims 135-139 (which are not mentioned in this rejection) and add the further limitation that the transfer transistor gate stack introduced by claims 135-139 is located at least partially beneath "said nitrogen containing insulating layer."

These claims require an imaging device comprising a photogate being located over a "nitrogen containing layer," and a "gatestack. . . over an insulating layer of silicon dioxide disposed over said substrate" but at least partially under the "nitrogen containing layer." None of the cited references, whether considered alone or in combination, teach or suggest these claim limitations. In fact, none of the references suggest "a nitrogen containing layer" located under a photogate and at least "partially disposed over a gatestack" as required by the claims. For at least these reasons, the invention embodied by claims 126-134 and 140-144 is not rendered obvious by this combination of references.

Further, for at least the reasons mentioned above with respect to the previous rejection, there is no motivation for modifying the prior art as necessary to arrive at the claimed invention. Specifically, there is no motivation for selectively combining the references as suggested by the Office Action. Accordingly, even if the references taught or suggested every element recited by claims 126-134 and 140-144, which they do not, the rejection still would be improper, as it requires improper hindsight to combine the four references as suggested in the Office Action.

For at least these reasons, Appellant respectfully submits that the rejection of claims 126-134 and 140-144 under 35 U.S.C. §103 should be reversed.

## VIII. CONCLUSION

For the reasons given above it is respectfully submitted that the final rejection of claims 1-4, 7-15, 18-23, 25-29, 31-39, 41-63, 65, and 115-144 is improper. Accordingly, Appellant requests reversal of all rejections by this honorable Board.

Dated: January 12, 2005

Respectfully submitted,

By Megan S. Woodworth

Mark J. Thronson
Registration No.: 33,082
Megan S. Woodworth
Registration No.: 53,655
DICKSTEIN SHAPIRO MORIN & OSHINSKY LLP
2101 L Street NW
Washington, DC 20037-1526
(202) 785-9700
Attorneys for Applicant

## APPENDIX A

1. An imaging device comprising:

a substrate;

a photosensitive area within said substrate for accumulating photo-generated charge in said area;

a photogate for controlling the accumulation of photo-generated charge in said photosensitive area;

a first and a second gate stack;

a first insulating layer in contact with said substrate and beneath each of said first and second gate stacks; and

a nitrogen containing second insulating layer distinct from said first insulating layer, said second insulating layer being in contact with said substrate and being located beneath said photogate.

2. The imaging device according to claim 1, wherein said photogate includes a doped polysilicon layer deposited over said second insulating layer.

3. The imaging device according to claim 1, wherein said photogate includes a transparent or semi-transparent conductor deposited over said second insulating layer.

4. The imaging device according to claim 3, wherein said transparent or semi-transparent conductor is selected from the group consisting of indium-tin-oxide, tin oxide, indium oxide and doped hydrogenated amorphous silicon.

7. The imaging device according to claim 1, wherein said nitrogen containing insulating layer is a silicon nitride layer.

8. The imaging device according to claim 1, wherein said nitrogen containing insulating layer is a nitrogen oxide containing layer.

9. The imaging device according to claim 8, wherein said nitrogen containing insulating layer is ONO.

10. The imaging device according to claim 8, wherein said nitrogen containing insulating layer is NO.

11. The imaging device according to claim 8, wherein said nitrogen containing insulating layer is ON.

12. The imaging device according to claim 2, wherein said nitrogen containing insulating layer is a silicon nitride layer.

13. The imaging device according to claim 2, wherein said nitrogen containing insulating layer is an ONO layer.

14. An imaging device including a semiconductor integrated circuit substrate, said imaging device comprising:

a photosensitive device, including a photogate overlying said substrate, for accumulating photo-generated charge in a photosensitive area of said substrate;

a readout circuit comprising at least an output transistor formed in said substrate for reading out charge from a node which stores said photogenerated charge;

a reset transistor for periodically resetting said charge storage node to a predetermined voltage; and

a nitrogen containing insulating material in contact with said substrate and beneath said photogate.

15. The imaging device according to claim 14, further comprising a charge transfer region for receiving charge from said photosensitive area having a control terminal, said transfer region being formed in said substrate adjacent said photosensitive area and having a node connected to a gate of said output transistor.

18. The imaging device according to claim 15, further comprising at least one charge transfer device for transferring charge from said photosensitive area to said node in accordance with a control signal applied to said control terminal.

19. The imaging device according to claim 14, wherein said nitrogen containing insulating material is a silicon nitride layer.

20. The imaging device according to claim 14, said nitrogen containing insulating material is a nitrogen oxide containing layer.

21. The imaging device according to claim 20, said nitrogen containing insulating material is an ONO layer.

22. The imaging device according to claim 20, said nitrogen containing insulating material is an NO layer.

23. The imaging device according to claim 20, said nitrogen containing insulating material is an ON layer.

25. The imaging device according to claim 14, wherein said photogate includes a doped polysilicon layer deposited over said insulating layer.

26. The imaging device according to claim 14, wherein said photogate includes a transparent or semi-transparent conductor deposited over said insulating layer.

27. The imaging device according to claim 26, wherein said transparent or semi-transparent conductor is selected from the group consisting of indium-tin-oxide, tin oxide, indium oxide and doped hydrogenated amorphous silicon.

28. An imaging system comprising:

a plurality of active pixel sensors arranged in an array of rows and columns, each active pixel sensor being operable to generate a voltage at a diffusion node corresponding to detected light intensity by the sensor;

a photogate formed over a charge collection area in a substrate in said pixel sensor, wherein a nitrogen containing insulating layer is in contact with said substrate and beneath said photogate;

a reset device to periodically reset the voltage of said diffusion node;

a row decoder having a plurality of control lines connected to the sensor array, each control line being connected to activate the sensors in a respective row; and

a plurality of output circuits, each output circuit being connected to the respective sensors in a column, operable to store voltage signals received from the sensors and to provide a sensor output signal.

29. The imaging system according to claim 28, further comprising a transfer transistor to transfer charge from said charge collection area to said diffusion node.

31. The imaging system according to claim 28, wherein said nitrogen containing insulating layer is a grown layer.

32. The imaging system according to claim 28, wherein said nitrogen containing insulating layer is a deposited layer.

33. The imaging system according to claim 28, wherein said nitrogen containing insulating layer is a silicon nitride layer.

34. The imaging system according to claim 28, wherein said nitrogen containing insulating layer is a nitrogen oxide containing layer.

35. The imaging system according to claim 34, wherein said nitrogen containing insulating layer is an ONO layer.

36. The imaging system according to claim 34, wherein said nitrogen containing insulating layer is an NO layer.

37. The imaging system according to claim 34, wherein said nitrogen containing insulating layer is an ON layer.

38. The imaging system according to claim 33, wherein said silicon nitride insulating layer is a chemical vapor deposition deposited layer.

39. An imaging system comprising:

a plurality of active pixel sensors arranged in an array of rows and columns, each active pixel sensor being operable to generate a voltage at a floating diffusion node corresponding to detected light intensity by the sensor;

a photogate formed over a charge collection area in a substrate in said pixel sensor, wherein a nitrogen containing insulating layer is in contact with said substrate and beneath said photogate;

a reset device to periodically reset the voltage of said diffusion node;

a row decoder having a plurality of control lines connected to the sensor array, each control line being connected to activate the sensors in a respective row; and

a plurality of output circuits, each output circuit being connected to the respective sensors in a column, operable to store voltage signals received from the sensors and to provide a sensor output signal.

41. The imaging system according to claim 39, wherein said nitrogen containing insulating layer is a grown layer.

42. The imaging system according to claim 39, wherein said nitrogen containing insulating layer is a deposited layer.

43. The imaging system according to claim 39, wherein said photogate includes a doped polysilicon layer deposited over said nitrogen containing insulating layer.

44. The imaging system according to claim 39, wherein said photogate includes a transparent or semi-transparent conductor deposited over said insulating layer.

45. The imaging system according to claim 44, wherein said transparent or semi-transparent conductor is selected from the group consisting of indium-tin-oxide, tin oxide, indium oxide and doped hydrogenated amorphous silicon .

46. The imaging system according to claim 39, wherein said nitrogen containing insulating layer is a silicon nitride layer.

47. The imaging system according to claim 39, wherein said nitrogen containing insulating layer is a nitrogen oxide containing layer.

48. The imaging system according to claim 47, wherein said nitrogen containing insulating layer is an ONO layer.

49. The imaging system according to claim 47, wherein said nitrogen containing insulating layer is an NO layer.

50. The imaging system according to claim 47, wherein said nitrogen containing insulating layer is an ON layer.

51. The imaging system according to claim 46, wherein said silicon nitride insulating layer is a chemical vapor deposition deposited layer.

52. The imaging system according to claim 48, wherein said ONO insulating layer is a chemical vapor deposition deposited layer.

53. A system comprising:

(i) a processor for processing image data; and

(ii) a CMOS imaging device for providing image data to said processor and including:

a substrate;

a photosensitive area within said substrate for accumulating photo-generated charge in said area;

a photogate for controlling the accumulation of photo-generated charge in said photosensitive area; and

a nitrogen containing insulating layer in contact with said substrate and beneath said photogate.

54. The imaging device according to claim 53, wherein said photogate includes a doped polysilicon deposited over said insulating layer.

55. The imaging device according to claim 53, wherein said photogate includes a transparent or semi-transparent conductor deposited over said insulating layer.

56. The imaging device according to claim 55, wherein said transparent or semi-transparent conductor is selected from the group consisting of indium-tin-oxide, tin oxide, indium oxide and doped hydrogenated amorphous silicon .

57. The imaging device according to claim 53, wherein said nitrogen containing insulating layer is a grown layer.

58. The imaging device according to claim 53, wherein said nitrogen containing insulating layer is a deposited layer.

59. The imaging device according to claim 53, wherein said nitrogen containing insulating layer is a silicon nitride layer.

60. The imaging device according to claim 53, said nitrogen containing insulating layer is a nitrogen oxide containing layer.

61. The imaging device according to claim 60, wherein said nitrogen containing insulating layer is ONO.

62. The imaging device according to claim 60, wherein said nitrogen containing insulating layer is NO.

63. The imaging device according to claim 60, wherein said nitrogen containing insulating layer is ON.

65. The imaging device according to claim 53, said nitrogen containing insulating layer is an ONO layer.

115. The imaging device according to claim 1, wherein said nitrogen containing layer has been removed wherever it is not covered by said photogate.

116. The imaging device according to claim 14, wherein said nitrogen containing layer has been removed wherever it is not covered by said photogate.

117. The imaging system according to claim 28, wherein said nitrogen containing layer has been removed wherever it is not covered by said photogate.

118. The imaging system according to claim 39, wherein said nitrogen containing layer has been removed wherever it is not covered by said photogate.

119. The imaging system according to claim 53, wherein said nitrogen containing layer has been removed wherever it is not covered by said photogate.

120. The imaging device according to claim 1, wherein said first insulating layer is a layer of silicon dioxide.

121. The imaging device according to claim 14, further comprising a gate stack over said substrate, wherein said gate stack is disposed over an insulating layer of silicon dioxide which is over said substrate.

122. The imaging system according to claim 28, further comprising a gate stack over said substrate, wherein said gate stack is disposed over an insulating layer of silicon dioxide disposed over said substrate.

123. The imaging system according to claim 39, further comprising a gate stack over said substrate, wherein said gate stack is disposed over an insulating layer of silicon dioxide disposed over said substrate.

124. The imaging system according to claim 53, wherein said imaging device further comprises a gate stack over said substrate, wherein said gate stack is disposed over an insulating layer of silicon dioxide which is over said substrate.

125. The imaging device according to claim 115, wherein said first insulating layer is a layer of silicon dioxide.

126. The imaging device according to claim 116, further comprising a gate stack over said substrate and beneath said insulating layer, wherein said gate stack is disposed over an insulating layer of silicon dioxide which is over said substrate.

127. The imaging system according to claim 117, further comprising a gate stack over said substrate and beneath said insulating layer, wherein said gate stack is disposed over an insulating layer of silicon dioxide disposed over said substrate.

128. The imaging system according to claim 118, further comprising a gate stack over said substrate and beneath said insulating layer, wherein said gate stack is disposed over an insulating layer of silicon dioxide disposed over said substrate.

129. The imaging system according to claim 119, wherein said imaging device further comprises a gate stack over said substrate and beneath said insulating layer, wherein said gate stack is disposed over an insulating layer of silicon dioxide which is over said substrate.

130. The imaging device according to claim 120, wherein each of said photogate and said nitrogen containing second insulating layer is only partially disposed over said first gate stack.

131. The imaging device according to claim 121, wherein said photogate and said nitrogen containing insulating layer are only partially disposed over said gate stack.

132. The imaging system according to claim 122, wherein said photogate and said nitrogen containing insulating layer are only partially disposed over said gate stack.

133. The imaging system according to claim 123,wherein said photogate and said nitrogen containing insulating layer are only partially disposed over said gate stack.

134. The imaging device according to claim 124, wherein said photogate and said nitrogen containing insulating layer are only partially disposed over said gate stack.

135. The imaging device according to claim 120, wherein said first gate stack is a transfer gate stack and said second gate stack is a reset gate stack.

136. The imaging device according to claim 121, wherein said gate stack comprises a transfer transistor gate stack.

137. The imaging system according to claim 122, wherein said gate stack comprises a transfer transistor gate stack.

138. The imaging system according to claim 123, wherein said gate stack comprises a transfer transistor gate stack.

139. The imaging device according to claim 124, wherein said gate stack comprises a transfer transistor gate stack.

140. The imaging device according to claim 135, wherein said nitrogen containing second insulating layer is disposed over a portion of said transfer gate stack.

141. The imaging device according to claim 136, wherein said nitrogen containing insulating layer is disposed over a portion of said transfer gate stack.

142. The imaging system according to claim 137, wherein said nitrogen containing insulating layer is disposed over a portion of said transfer gate stack.

143. The imaging system according to claim 138, wherein said nitrogen containing insulating layer is disposed over a portion of said transfer gate stack.

144. The imaging device according to claim 139, wherein said nitrogen containing insulating layer is disposed over a portion of said transfer gate stack.

*Effective on 12/08/2004.*
*Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818).*

# FEE TRANSMITTAL
## For FY 2005

☐ Applicant claims small entity status. See 37 CFR 1.27

**TOTAL AMOUNT OF PAYMENT** ($) 500.00

| Complete if Known | |
|---|---|
| Application Number | 09/172,298-Conf. #9094 |
| Filing Date | October 14, 1998 |
| First Named Inventor | Howard E. Rhodes |
| Examiner Name | G. M. Munson |
| Art Unit | 2811 |
| Attorney Docket No. | M4065.0101/P101 |

**METHOD OF PAYMENT** (check all that apply)

☐ Check ☒ Credit Card ☐ Money Order ☐ None ☐ Other (please identify): ____

☑ Deposit Account Deposit Account Number: 04-1073 Deposit Account Name: Dickstein Shapiro Morin & Oshinsky LLP

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

☑ Charge fee(s) indicated below ☐ Charge fee(s) indicated below, **except for the filing fee**

☑ Charge any additional fee(s) or any underpayment of fee(s) under 37 CFR 1.16 and 1.17 ☒ Credit any overpayments

**FEE CALCULATION**

**1. BASIC FILING, SEARCH, AND EXAMINATION FEES**

| | FILING FEES | | SEARCH FEES | | EXAMINATION FEES | | |
|---|---|---|---|---|---|---|---|
| Application Type | Fee ($) | Small Entity Fee ($) | Fee ($) | Small Entity Fee ($) | Fee ($) | Small Entity Fee ($) | Fees Paid ($) |
| Utility | 300 | 150 | 500 | 250 | 200 | 100 | |
| Design | 200 | 100 | 100 | 50 | 130 | 65 | |
| Plant | 200 | 100 | 300 | 150 | 160 | 80 | |
| Reissue | 300 | 150 | 500 | 250 | 600 | 300 | |
| Provisional | 200 | 100 | 0 | 0 | 0 | 0 | |

**2. EXCESS CLAIM FEES**

| Fee Description | Fee ($) | Small Entity Fee ($) |
|---|---|---|
| Each claim over 20 or, for Reissues, each claim over 20 and more than in the original patent | 50 | 25 |
| Each independent claim over 3 or, for Reissues, each independent claim more than in the original patent | 200 | 100 |
| Multiple dependent claims | 360 | 180 |

| Total Claims | | Extra Claims | | Fee ($) | | Fee Paid ($) |
|---|---|---|---|---|---|---|
| 88 | - 88 = | | x | | = | |

| Indep. Claims | | Extra Claims | | Fee ($) | | Fee Paid ($) |
|---|---|---|---|---|---|---|
| 4 | - 4 = | | x | | = | |

**Multiple Dependent Claims**

| Fee ($) | Fee Paid ($) |
|---|---|
| | |

**3. APPLICATION SIZE FEE**

If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

| Total Sheets | | Extra Sheets | | Number of each additional 50 or fraction thereof | | Fee ($) | | Fee Paid ($) |
|---|---|---|---|---|---|---|---|---|
| | - 100 = | | /50 | | (round **up** to a whole number) x | | = | |

**4. OTHER FEE(S)** **Fees Paid ($)**

Non-English Specification, $130 fee (no small entity discount)

Other: 1402 Filing a brief in support of an appeal 500.00

| SUBMITTED BY | | | | | |
|---|---|---|---|---|---|
| Signature | [signature] | Registration No. (Attorney/Agent) | 33,082 | Telephone | (202) 775-4742 |
| Name (Print/Type) | Mark J. Thronson | | | Date | January 12, 2005 |